

## FOREIGN EXPERIENCE

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### LUBISOL MATERIALS FOR REDUCING HEAT LOSSES IN THE GLASS-MELTING FURNACE

S. Luchkanov<sup>1</sup>Translated from *Steklo i Keramika*, No. 11, pp. 38 – 39, November, 2006.

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Lubisol Co. has developed a new method for hot maintenance and hermetic sealing of silicate roofs that will allow significantly prolonging their lifetime and reducing heat losses in the glass-melting furnace.

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Over the past 50 years, 2 – 3 layers of Dinas lightweight brick have been used for insulating furnace roofs. The increase in the efficiency of existing insulation has opened up broad prospects for improving the energy efficiency of furnaces and decreasing fuel consumption.

In current conditions where energy conservation is especially critical, Lubisol Engineering Co. has developed and successfully tested technology for thermal insulation and hermetic sealing of Dinas roofs in more than 100 furnaces; the technology significantly reduces heat losses through the roof and also prolongs its lifetime.

**Thermal insulation of the roof.** Heat losses through a roof of the usual design made of 2 – 3 layers (150 – 200 mm) of Dinas lightweight brick are approximately 2000 – 2500 W/m<sup>2</sup>. A further increase in the thickness of the roof is not justified, since the thermal conductivity of Dinas increases with an increase in the temperature. A much better solution is to combine lightweight blocks with more efficient insulating materials. These materials include Lubisol Si-Seal, which is the result of the company's 20 years of experience in thermal insulation and hermetic sealing of the Dinas roofs of glass-melting furnaces.

The standard solution proposed (Fig. 1) is a 30-mm layer of Lubisol Si-Seal applied directly on the Dinas roof; then the following are successively applied:

- a layer of Dinas lightweight brick 64 mm thick;

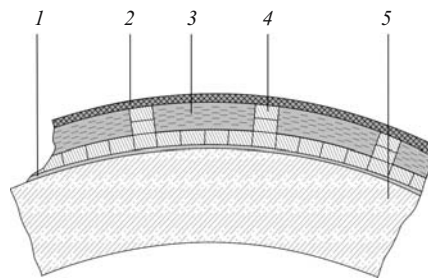
- a layer of Lubisol 2-SL superlight thermal insulation 114 mm thick;

- a layer of Lubisol 3 Covering Cement 30 mm thick.

The heat losses through the roof of this design reach 1000 W/m<sup>2</sup>, i.e., the savings is 1000 – 1500 W/m<sup>2</sup>, or 1.5 – 2.0% of the furnace's total power consumption.

The extensive experience in using this technology allows varying the design to obtain the optimum result in each concrete case. Long observations demonstrated the high efficiency with respect to saving fuel and preventing roof burn-out. Melting takes place at the same temperatures, and the only difference was a reduction in gas or furnace fuel consumption.

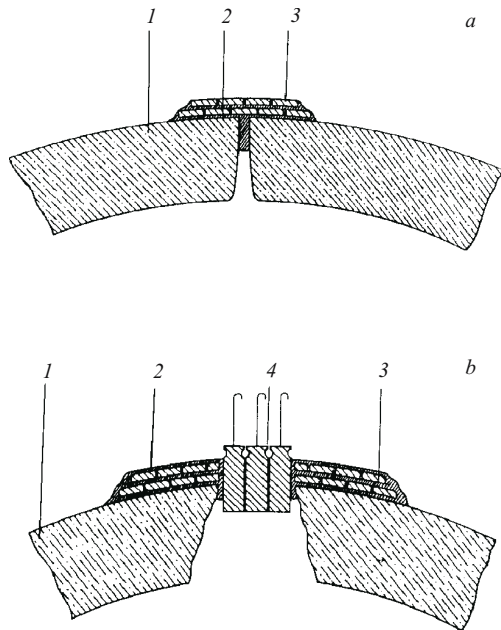
The main feature of the Lubisol thermal insulating system is the low density and high insulating efficiency due to the low thermal conductivity — approximately 50% lower than for Dinas lightweight brick. Lubisol 2-SL superlight insulation has a density of 0.33 kg/dm<sup>3</sup> and thermal conductivity of 0.08 W/(m · K). the required thickness of the insulation is correspondingly less. In addition, its cost is lower than the cost of traditional roof insulation. For this reason, the possibility of using very light and effective thermal insulation with a short payback period is now offered to glass-works.



**Fig. 1.** Diagram of thermal insulation of Dinas roofs in glass-melting furnaces proposed by Lubisol Co.: 1) Si-Seal material; 2) covering cement; 3) Lubisol 2-SL superlight insulation; 4) Dinas lightweight brick; 5) Dinas roof.

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<sup>1</sup> Lubisol Engineering Co., Bulgaria.



**Fig. 2.** Repaired Dinas roofs in glass-melting furnaces for small (*a*) and important (*b*) burnouts: 1) Dinas roof; 2) Si-Seal material; 3) silicate plate; 4) overhead block.

Lubisol material has now been used in construction of more than 100 furnaces worldwide, including the oxy-fuel furnace at Vetrobalsamo in Italy. The 85 m<sup>2</sup> roof in this furnace was insulated with Lubisol materials in 2004. The usual problems for oxy-fuel furnaces related to burnouts and corrosion of the roof that require hot repairs were detected in the previous campaign of this furnace. For the second campaign, Lubisol materials were used and even now, after operating for 2 years, the roof is in excellent shape — with no cracks or burnouts. The heat losses through the roof decreased from 2500 to 1000 W/m<sup>2</sup>. The savings due to the reduced power consumption were 34,000 euros, and the condition of the roof suggests that it will have a ten-year lifetime.

**Prolonging the lifetime of the roof.** The basic factor that limits the lifetime of silicate roofs is alkaline condensation corrosion and subsequent perforation of the roof. For

furnaces working with aggressive glass, the roof lifetime is determining for the duration of the campaign of the entire furnace. Popularization of the oxy-fuel method has made problems of roof corrosion even more important for the glass industry.

Lubisol Co. has developed a method of prolonging the lifetime of the roof based on blocking corrosion by halting gas exchange through cracks. Two-component Si-Seal compound was developed to ensure good adhesion to silicate blocks in a wide range of temperatures — from 100 to 1620°C. A distinctive feature of Si-Seal material is the TCLE, similar to the TCLE of silicate blocks, while other repair materials have much lower TCLE.

In using the proposed method, repair of the holes formed after application of a layer of Si-Seal 15 mm thick and two layers of silicate plates 30 mm thick on a section measuring approximately 500 × 500 mm around the hole is provided for (Fig. 2*a*).

The method was tested on different furnaces, including oxy-fuel furnaces. Relatively important holes — up to 1 m<sup>2</sup> — were repaired in some furnaces. Overhead blocks were used in addition to the silicate plates (Fig. 2*b*).

Since 1999, Lubisol Co. has regularly monitored the temperature of the cold side of the repaired sections. During this time, none of them exhibited any important increase in temperature or renewed corrosion. Based on these observations, the company arrived at the following conclusion: in hermetic sealing of the silicate roof in the region of perforation with Si-Seal paste and silicate plates, corrosion totally halts. As a result of only one repair, the lifetime of the roof can thus be significantly lengthened.

The new method developed by Lubisol for hot repair and hermetic sealing of silicate roofs allows significantly prolonging the lifetime of the roof and reducing heat losses in the glass-melting furnaces.

Hermetic sealing of the roof is recommended on all new furnaces, but especially on furnaces where the duration of the campaign is determined by the lifetime of the roof. Hermetic sealing in all roofs subject to corrosion is also recommended.